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OPERANT CONDITIONING OF FOOT THRUSTS IN INFANTS AND CONCOMITANT EFFECTS ON NON-REINFORCED SOCIAL BEHAVIORS

An abstract of a Thesis by
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The problem. It has been reported by some investigators that behaviors not directly reinforced increase during the course of operant conditioning with infants. Specifically, smiling and cooing appear to emerge as the result of exposure to operant contingencies designed to increase motor responding. Previous studies have failed to gather objective data on this phenomenon. The purpose of this study is to record smiling and cooing behavior in infants exposed to positive reinforcement for foot thrusts.

Procedure. Three two-month-old infants were exposed to a mobile which could be activated by their foot thrusts. During daily ten-minute sessions the rate of foot thrusts and the percentage of five-second intervals in which the infant smiled and cooed were assessed for baseline (stationary mobile) and contingent stimulation conditions.

Findings. Of the three subjects, only one learned to operate the mobile by foot thrusts. One subject was dropped from the study after it was learned that he had access to another mobile and another did not condition. For the subject who learned to control the mobile, smiling did not vary systematically across conditions. In contrast to this, cooing clearly increased after a few days of exposure to contingent stimulation.

Conclusions. Operant conditioning with infants is not as straightforward as might be assumed, but when it is accomplished, increases in a non-reinforced behavior (cooing) occur in addition to increases in the reinforced responses.

Recommendations. Possible explanations for the increased cooing were presented. Further research might be directed to determine which explanation best accounts for this phenomenon.

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CHAPTER I

REVIEW OF LITERATURE

Over the past twenty years reports of operant conditioning with infants have appeared in increasing numbers. Researchers have demonstrated operant control over such motor responses of infants as head turns (Siqueland, 1964; Siqueland & Lipsitt, 1966) and foot kicks (Rovee & Rovee, 1969; Sheppard, 1969). Social responses such as smiling (Brackbill, 1958; Etzel & Gewirtz, 1967) and vocalizing (Rheingold, Gewirtz & Ross, 1959; Weisberg, 1963) also have been shown to be subject to modification through the contingent presentation of environmental events.

Several reinforcing stimuli have been used in infant studies. Milk presented via a nipple has been used extensively (e.g., Papoušek, 1961; Siqueland, 1964; Clifton, Meyers & Solomon, 1972; Hillman & Bruner, 1972). Other reinforcers include the opportunity to engage in non-nutritive sucking (Siqueland, 1968) and the presentation of auditory stimulation in the form of a tone (Ramey & Watson, 1972) or music (Finklestein & Ramey, 1977). Visual reinforcers such as the presentation of a slide of a female face (Finklestein & Ramey, 1977) and mobile movement (Rovee & Rovee, 1969; Fagen & Rovee, 1976; Rovee & Fagen, 1976) have been used alone or with an auditory component. Social stimuli such as eye contact, smiling, talking and touching have been found to be effective reinforcers when used in a package form (Brackbill, 1958; Rheingold et al., 1959; Routh, 1969) and as individual components (Schwartz, Rosenberg & Brackbill, 1970).

In addition to these findings some researchers report that behaviors not directly reinforced increase during the course of operant conditioning with infants. During a study on attentional preferences, Uzgiris and Hunt (1970) observed the emergence of laughing and cooing directed toward mobiles which were responsive to infants' leg kicking. In this study, infants were exposed to three different hanging patterns. Two of these patterns had been present in the home cribs for a few weeks prior to data collection (familiar patterns) and of these one was responsive to the infants' leg kicking while the other was not. As a measure of attention preference, observers recorded the length of time the infants gazed at each of the three patterns. In addition to finding that the infants gazed longer at the familiar patterns, these researchers note that several infants developed what they called a "relationship" with the responsive pattern.

> A baby's kicking would set the pattern in motion, and he watched the motion with such signs of delight as cooing and laughing until the movement almost stopped. He would then look intently as if concentrating on something difficult and kick

> again. As the pattern resumed swaying the signs of delight would reappear. (Uzgiris & Hunt, 1970, p. 6)

The researchers report no similar "relationship" developing between the infants and the unresponsive patterns.

Unfortunately, there are three methodological difficulties with this study. The first is related to the design of the experimental apparatus. In order to make the pattern responsive to the infant's movements, the researchers attached the mobiles directly to the side of the cribs. Because of the diversity in crib construction, the patterns were not equally responsive for all infants. Some infants had cribs which were so large and rigid that body movements had almost no effect on pattern movements, while for others even the slightest activity would start the pattern swaying. It was observed that only those infants with moderately mobile cribs developed a "relationship" with the responsive pattern, but such cases were too few for statistical tests.

The second difficulty is related to the experimental design. All infants were exposed to both stationary patterns and patterns that moved as a result of their leg kicking. Because the infants developed cooing and smiling behaviors while gazing at the responsive pattern only, the authors speculate that pattern responsiveness (i.e., the existence of a contingent relationship between the infant's leg kicking and the movement of the pattern) is crucial in the development of these behaviors. Unfortunately, it is impossible to determine whether cooing and smiling would also emerge in babies who were exposed to a pattern which moved independently of their behavior.

The third difficulty is that no objective data on smiling and cooing were gathered. Instead only anecdotal reports of these behaviors are presented.

In a study by Watson and Ramey (1972) the first two of the above difficulties were eliminated. This study was designed to demonstrate the operant conditioning of head movements in two-month-old infants. Three groups of infants were exposed to one of two different hanging patterns. For one group of eighteen infants the pattern automatically rotated each time a pressure sensitive pillow placed under the infant's head was activated (contingent mobile). Two control groups consisting of eleven infants each were exposed to either a stationary pattern [stabile (sic)] or a pattern that rotated every three to four seconds regardless of the infant's behavior (noncontingent mobile). As was expected, the rate of head movements increased in the contingent mobile group while it did not for the two control groups. In addition, the mothers of the infants exposed to the contingent mobile reported a second type of reaction to the mobile. After approximately three to five days of exposure to the contingent mobile these infants "...blossomed into smiling and cooing..." (Watson & Ramey, 1972, p. 224). Infants in the control groups did not display this "socio-emotional" reaction.

As in the study by Uzgiris and Hunt, no data on smiling and cooing are available and the researchers base their report of these behaviors on the observations of the infants' mothers.

An interesting extension of this study has been reported by Watson (1971). At the conclusion of the home study above, infants from the three groups were brought to a laboratory situation in which operation of the mobile was made contingent upon head movement for all infants. It was found that only those infants exposed to either the contingent mobile or the stabile in the home were able to learn to control the mobile in the laboratory. A resistance to conditioning seemed to develop in the infants who had initially been exposed to the noncontingent mobile. In a follow-up study six weeks later the results were the same. It is not reported whether infants who later learned to control the mobile in the laboratory also demonstrated smiling and cooing.

Watson (1972) reports three additional experiments with the contingent and noncontingent mobiles conducted by himself, Peter Vietze and Lynn Dorman. In the first experiment, infants were exposed to the contingent mobile for ten minutes each morning and the noncontingent mobile for ten minutes each afternoon. In an attempt to facilitate discrimination between the conditions the experimenters constructed distinctively different visual stimuli for each of the two mobiles. The unexpected results were that response rates for all infants rose initially during both conditions (indicating stimulus generalization) and then gradually tapered off to approximately beginning levels (indicating generalized extinction). None of the infants in this experiment developed smiling and cooing.

At the same time the above experiment was being conducted, a second experiment was initiated to measure the effects of different rates of reinforcement on response rates. For one group of infants the mobile turned after forty-percent of their head movements while for another group the mobile turned after sixty-percent of their responses. Response rates for both groups did not increase reliably over the fourteen sessions of exposure to the contingencies, nor did smiling or cooing emerge.

Infants in the third experiment were again exposed to the contingent mobile as in the original Watson and Ramey study. Head movements activated the mobile for half the subjects in this study while for the other half, feet movements were reinforced. Response rates for all infants increased and the mothers again reported the emergence of vigorous smiling and cooing.

The data presented in these studies suggest that operant conditioning with infants may be accomplished under certain conditions and that when some motor responses are learned, the emergence of smiling and cooing may also occur. Before an analysis of these non-reinforced social behaviors can be begun, more precise data on their emergence are needed. The purpose of this study is to replicate the general procedures used by Watson and Ramey so that smiling and cooing in infants exposed to operant contingencies can be more closely studied. A reliable system for recording these behaviors will be developed. This will constitute a first step in understanding the emergence of smiling and cooing in infants exposed to contingencies of positive reinforcement for motor responses.

CHAPTER II

METHOD

Subjects

Three infants who ranged in age from 7 weeks 3 days to 8 weeks 5 days at the onset of this study served as subjects. One subject attended the Mercy Child Development Center affiliated with Mercy Hospital in Des Moines, Iowa. The other two infants were being reared at home and were identified through the use of birth announcements published in a local newspaper. Table 1 provides additional information about the subjects.

All infants were products of normal, full-term pregnancies and were of good general health and normal development throughout the study.

Setting

Sessions were conducted in the home cribs for the two home-reared infants. Prior to the onset of each session distracting stimuli (i.e., wall pictures, toys, etc.) were removed from the view of the infant. For the infant attending the child care center, sessions were conducted in a crib supplied by the center. The crib was located in a room which was unfamiliar to the infant. Again, an attempt was made to minimize or remove distracting stimuli.

Table 1

Sex, age and setting information pertaining to the subjects participating in the study

Subject	Sex	Age	Setting
1	female	7 weeks 3 days	day care center
2	male	7 weeks 6 days	home
3	male	8 weeks 5 days	home

Apparatus

A specially constructed mobile was used. Basically the mobile was an adaptation of the system used by Watson and Ramey (1972) with the major difference that foot thrusts served to operate the mobile rather than head movements.

A visual display consisting of four colored styrofoam spheres in a fixed cluster was suspended from a stand. When in position over the crib, the display hung approximately 18 inches above the infant's head. Located on the stand was a small electric motor (Dayton shaded pole brake gearmotor, stock number 3M231) which when activated by an electrical pulse rotated the sphere cluster for 1.5 seconds.

A special manipulandum was constructed consisting of a micro-switch mounted behind a hinged plexiglass panel, five inches high by ten inches wide. This was placed at one end of the crib and the infant was positioned such that foot thrusts coming into contact with the panel operated the micro-switch. The switch registered a response whenever it was depressed. The switch had to be released and depressed again in order for another response to be registered.

Response outputs were recorded via electrical circuitry housed in a sound attenuated box which formed the base of the mobile stand. A 28-volt direct current power supply, pulse former, timer, counter (Gerbrands) and relay circuitry automatically recorded the number of responses and reinforcements and programmed reinforcement delivery for each session.

Procedure

Prior to the onset of each session the mobile was positioned above the crib and the manipulandum was placed near the foot of the crib. Audio-video recording equipment (RCA Selectavision VHS recording deck, Sanyo black and white camera) was positioned to record the session. The infant's face but not the mobile was clearly recorded on video tape.

After the equipment was in place the infant was brought to the crib where s/he was placed in a supine position with the feet resting against the panel. The session was begun by turning on the mobile and video camera. Throughout the session the experimenter remained in the room out of the subject's view. A stop watch was used to monitor session length. At the completion of the session the infant was picked up and taken to another area while the apparatus was removed.

Usually one experimental session per day was conducted five days a week. On three occasions two sessions were conducted in a single day for each of the three subjects. Sessions were terminated early if the subject cried for longer than one minute or fell asleep. These events occurred five times for Subject 1, four times for Subject 2 and twice for Subject 3. Data from sessions which were shorter than five minutes were discarded. This occurred once for subjects 1 and 2.

Response Definitions and Recording Procedures

Three different responses were recorded. The frequency of foot thrusts was automatically recorded by the experimental apparatus. Rate of foot thrusts per minute was calculated for each session by dividing the total number of foot thrusts by the number of minutes in the session. Two other responses, smiling and cooing, were monitored and recorded by trained observers working from audio-video tapes of the sessions.

Written response definitions were presented to the observers and experience in and feedback on rating practice tapes were provided before the observers rated tapes from actual experimental sessions.

Smiling: Smiling was defined as "an elongation of the mouth outward and upward, a deepening of the naso-labial folds (lines) from the corners of the mouth to the wings of the nose, mouth may be open, wrinkles may form at the outer corners of the eyes as the eyes narrow, and the cheeks may bulge under the eyes." (Etzel & Gewirtz, 1967, p. 307)

Cooing: Cooing was defined as a discrete, voiced sound other than crying (loud, high pitched, rhythmic wails accompanied by tears), fussing (loud rhythmic wail, whimper, whine or screech which is not accompanied by tears), or grunting (expulsion of air from the mouth accompanied by tensing of the facial muscles). Vocalizations during and directly following yawning were not counted as cooing.

A five second interval recording procedure was used to record both smiling and cooing. Observers recorded one behavior at a time which required going through each tape twice, once for smiling and once for cooing. An auditory signal sounding every five seconds was superimposed on the session tape. At the sound of the signal, the observers recorded whether or not the target behavior had occurred during the preceding five seconds. The percentage of intervals during which smiling and cooing occurred was then calculated by dividing the number of intervals in which the behavior occurred by the total number of intervals in the session.

Experimental Conditions and Design

Throughout the study one of two conditions was in effect for each subject.

Baseline: In this condition foot thrusts were counted but did not operate the mobile. Instead the mobile remained stationary throughout the session.

Contingent Stimulation: During this condition rotation of the mobile was programmed following foot thrusts on a continuous reinforcement schedule. Each time the mobile was activated it rotated approximately 68° in the 1.5 second reinforcement period.

A simple reversal design was used to demonstrate the ...timulation on foot thrust rates. The initi... ...lation phases were followed by a retu...

Interobserver Reliability

Two independent observers were used for approxi... one third of all sessions to assess interobserver reliability. When both observers scored a particular interval identically, an agreement was scored. Interobserver reliability was calculated by dividing the number of agreements by the total number of intervals scored for each session. In order to minimize observer bias, observers were not informed of the condition in effect.

CHAPTER III

RESULTS

Foot Thrusts

Of the three infants participating in the study, only one clearly learned to control the mobile. Data on rate of foot thrusts for this subject are shown in Figure 1.

The mean rate of responding during the initial baseline phase for this subject was slightly over four responses per minute. During contingent stimulation, response rate reached a high point of over 14 responses per minute with a mean rate for the phase of almost 9. During the final baseline phase the mean rate dropped to 5.5 responses per minute.

Implementation of the contingent stimulation phase did not produce an immediate increase in rate of responding. By the fourth session of contingent stimulation, the response rate was well over baseline levels and remained there throughout the phase.

In addition to changes in the rate of responding, the topography of the foot thrusts also became modified. During the second session of contingent stimulation the response became so vigorous that the infant occasionally pushed her entire body away from the manipulandum. This made future responses more difficult to execute which may in part account for the particularly low rate obtained during that session. To eliminate this problem, the infant's head was rested

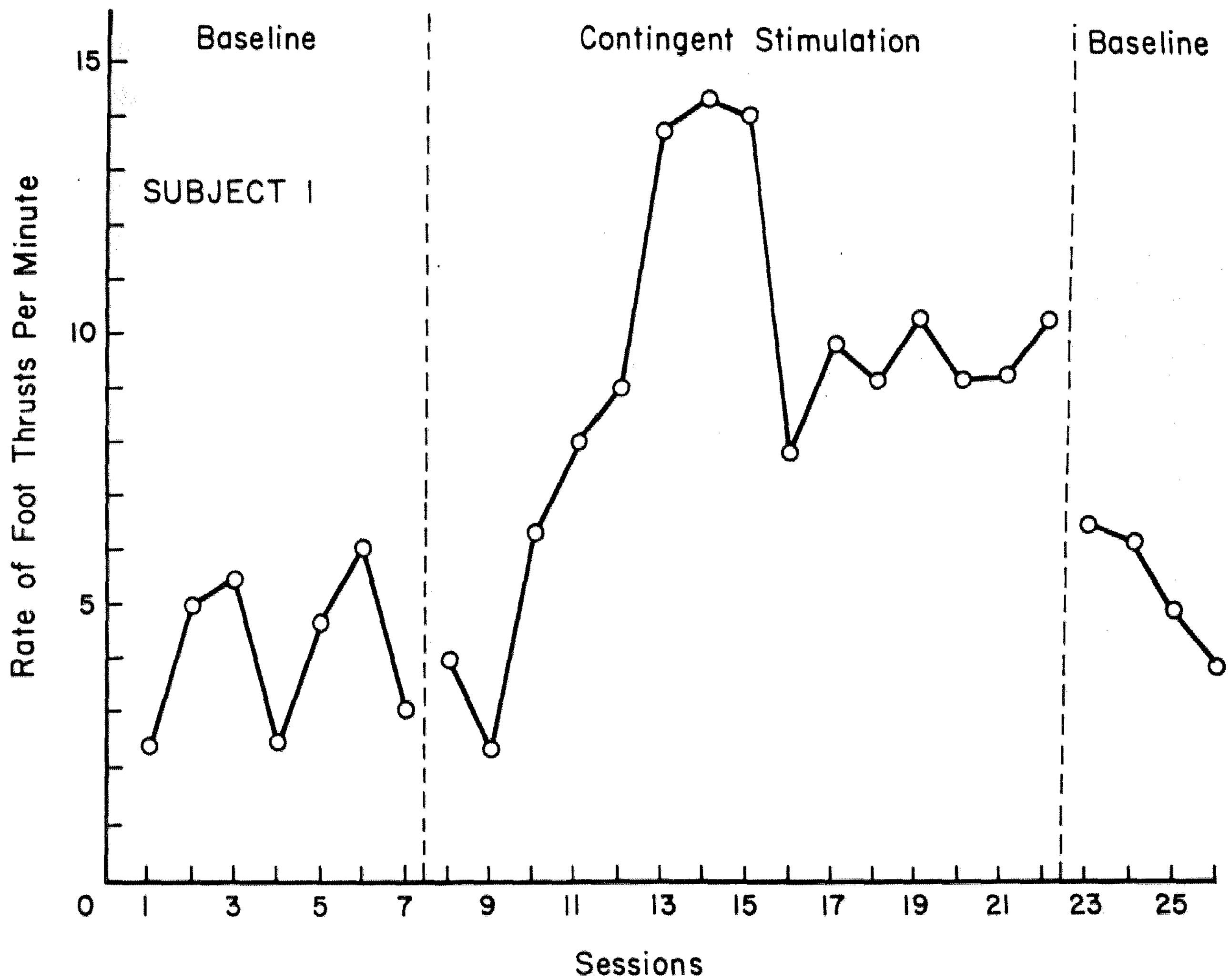

Figure 1. Rate of foot thrusts per minute as a function of baseline and contingent stimulation conditions for Subject 1.

against a padded board positioned at the head of the crib which prevented her from moving away from the manipulandum. The board extended beyond the sides of the crib and could be secured in a number of positions depending upon which slats of the crib side through which it extended.

Subject 2 yielded baseline rates of responding which were extremely unstable and much higher than those of the other subjects. Rates for this subject ranged from 4 responses per minute to over 57 responses per minute with a mean rate of 25.8. Such fluctuation in baseline responding is troublesome not only because it may cloud any effect the contingency condition might have on rate of responding, but also because it suggests that uncontrolled variables are operating on the behavior being studied.

Just prior to the eleventh baseline session this subject's mother said she thought her son might be too tired to kick because he had been kicking with his other mobile. After questioning this mother it was learned that the subject had access to another mobile which could be made to move when the infant kicked. The mobile was attached to the side of a small cradle and movements by the infant resulted in the mobile swaying. The infant was subsequently observed by the experimenter to kick quite vigorously while intently watching this mobile in motion. It was decided to discontinue the study with this subject because the effects of exposure to a second mobile could not be separated from the effects of planned experimental manipulations.

As can be seen in Figure 2, data from Subject 3 indicated that conditioning of the foot thrust response did not take place. The mean rate of responding during baseline for this subject was 6.9 responses per minute. For the contingent stimulation phase response rate averaged 8.9 per minute. With the exception of one session, response rates for contingent stimulation sessions fell within the range of those obtained during baseline. Due to difficulties with the availability of the video equipment, data collection with this subject was terminated after the twenty-second session.

Smiling

Data on smiling and cooing levels for the infant who showed conditioning are presented in Figures 3 and 4 respectively. During three sessions smiling and cooing data were lost due to faulty video-taping equipment. This occurred once in baseline (session 3) and twice during contingent stimulation (session 10 and 12).

As can be seen in Figure 3, the percentage of 5 second intervals during which the subject smiled did not vary systematically over baseline and contingent stimulation phases, but was rather variable over all phases. The mean percentage of smiling for the initial baseline phase was 6.7%, for contingent stimulation 6.9% and during the final baseline it was 3.9%. Interobserver reliability for smiling

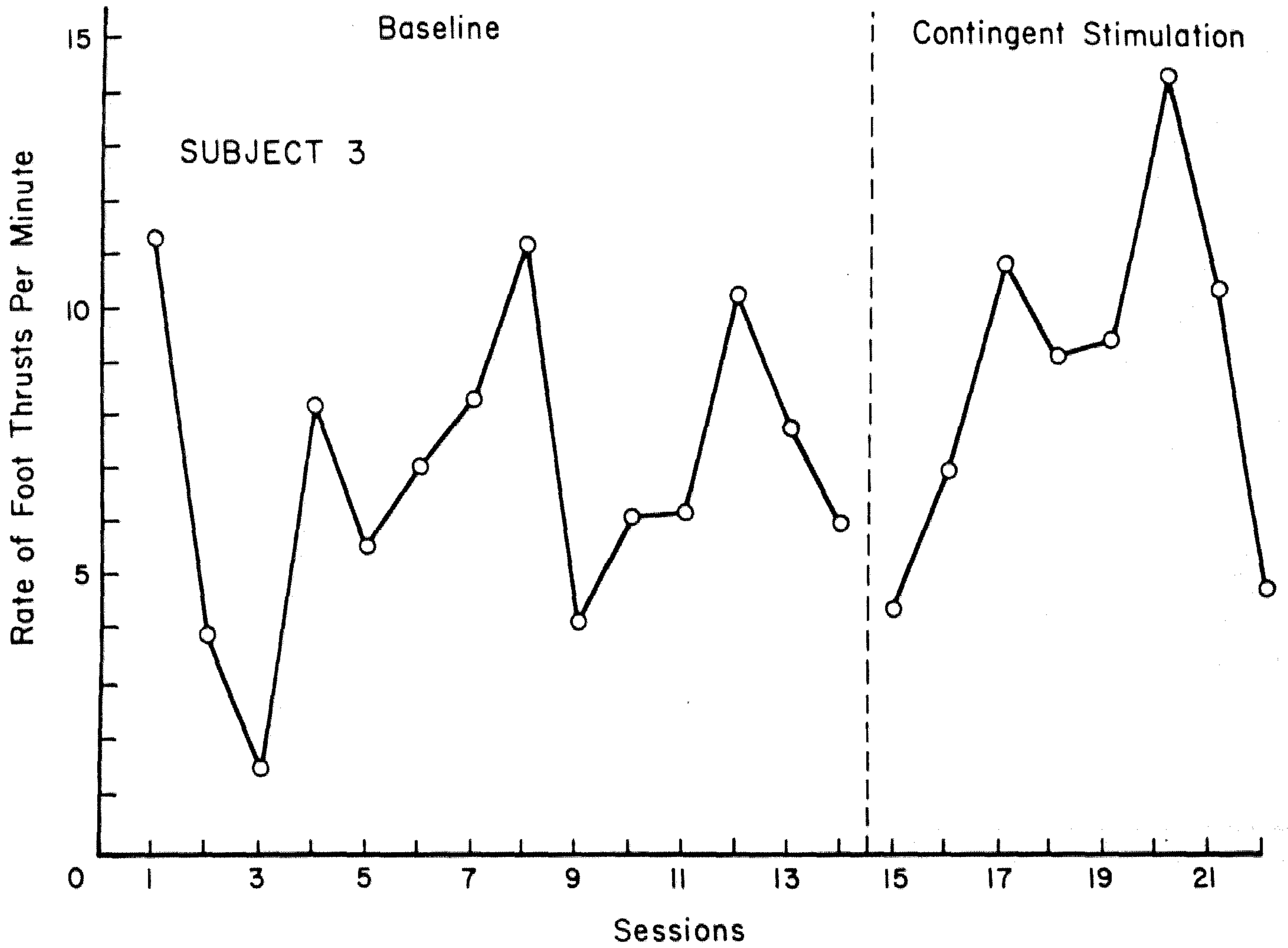

Figure 2. Rate of foot thrusts per minute as a function of baseline and contingent stimulation conditions for Subject 3.

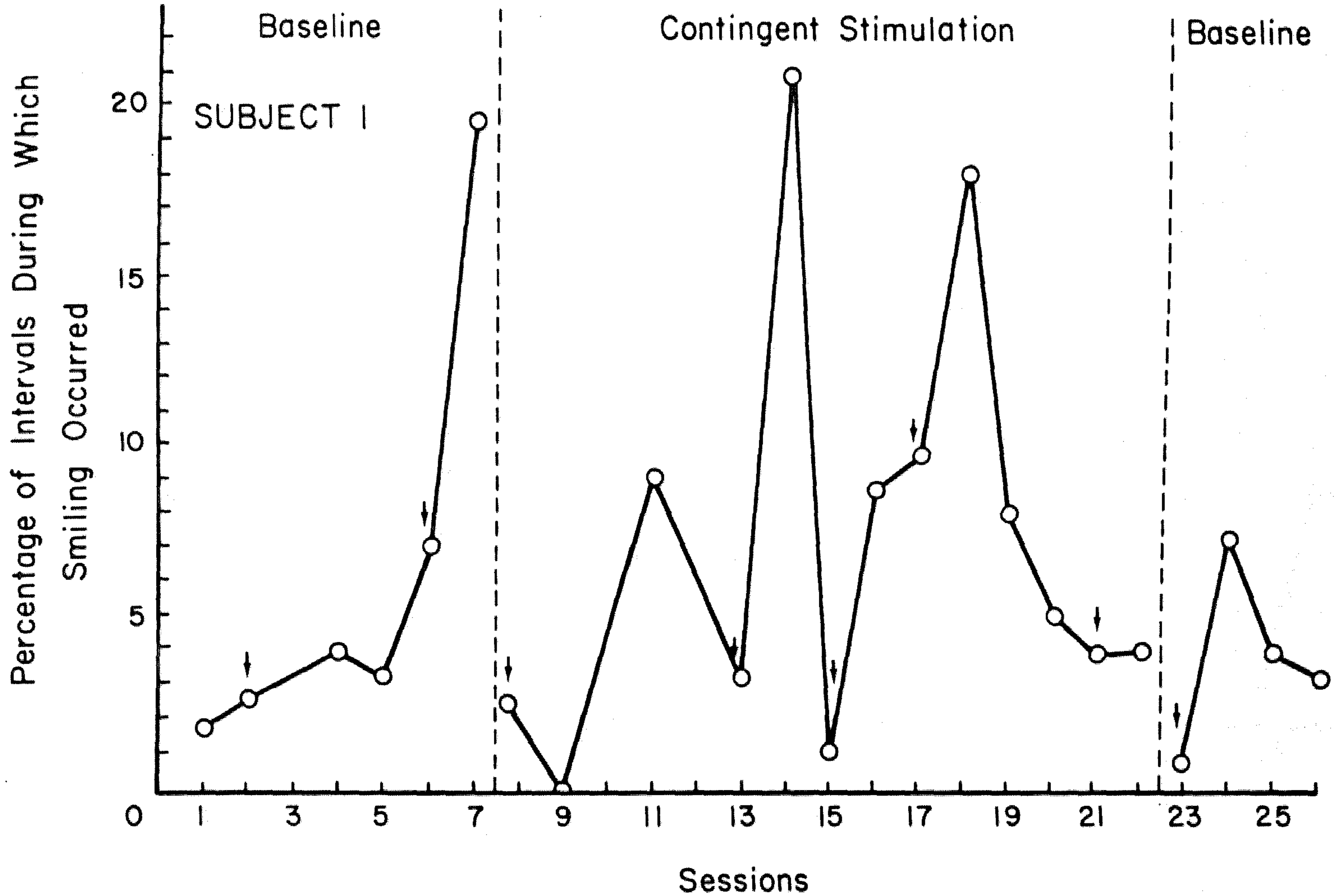

Figure 3. Percentage of intervals during which smiling occurred as a function of baseline and contingent stimulation conditions. Arrows indicate sessions during which reliability was assessed.

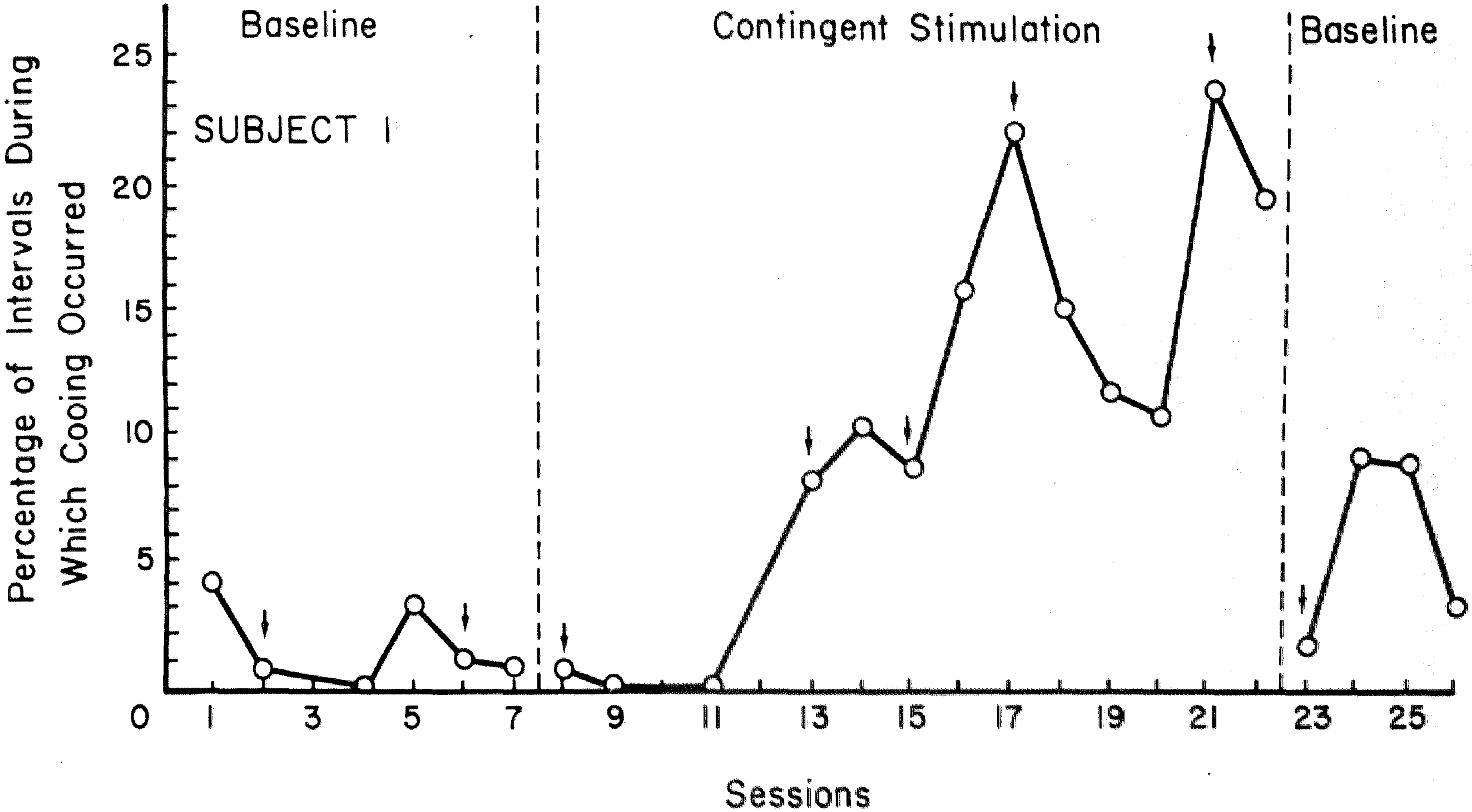

Figure 4. Percentage of intervals during which cooing occurred as a function of baseline and contingent stimulation conditions. Arrows indicate sessions during which reliability was assessed.

ranged from 90% to 99% with an average of 96% for the eight sessions it was assessed.

Cooing

The percentage of intervals in which cooing occurred increased during the contingent stimulation phase as can be seen in Figure 4. Initial baseline levels were quite stable and low with a mean percentage for the phase of 1.9%. Upon implementation of the contingency, cooing remained at or near zero until Session 13 when it occurred in over 8% of the intervals. The mean percentage of intervals during which cooing occurred was 11.5% for the contingent stimulation phase.

Upon reinstatement of baseline conditions in Session 23, the percentage of cooing immediately fell to under 2% of the intervals. In the following sessions it rose slightly and then fell again. For this phase the mean percentage of intervals during which cooing occurred was 5.8%.

Interobserver reliability for cooing ranged from 94% to 99% with an average of 98%.

CHAPTER IV

DISCUSSION

Because the effects of contingent stimulation on motor responding were inconsistent, general statements regarding this aspect of the study are unwarranted. Several factors may account for the disparate outcomes.

In the case of Subject 2 who demonstrated high, variable baseline rates of foot thrusting, generalization between the experimental mobile and the second mobile attached to the infant's cradle may have occurred. Results from daily exposure to both contingent and noncontingent mobiles have been reported by Watson (1972), but the effects of carefully controlled exposure to both contingent and stationary mobiles are not known. Research is needed to determine to what extent increases in response rate in the presence of a contingent mobile generalize when the infant is also exposed to a stationary mobile.

Informal observations made by the experimenter may help to account for the failure to condition by Subject 3. This subject was often observed to look at various stimuli around the room rather than at the mobile. Although there was some auditory stimulation associated with rotation of the mobile (the sound of the motor), not viewing the sphere cluster would greatly reduce its reinforcing value. Failure to condition may be the result of failure to "consume" the reinforcing stimuli.

It is also interesting to note that this subject came from the largest family in the study with siblings being several years older than the subject. The family members were observed to provide a large amount of social stimulation during playtime with this subject which may have either diluted the reinforcing value of the nonsocial contingencies or created a resistance to conditioning as was reported by Watson (1971).

That one subject showed differential response rates during the baseline and contingent stimulation conditions is clear. Because of the experimental design it cannot be determined if movement of the mobile served as a reinforcer or an elicitor of foot thrusting for this subject. The findings of Watson and Ramey (1972) strongly suggest that an operant contingency must exist in order for motor response rates to increase.

One set of data lends support to the notion that operant conditioning accounts for the changes in response rate. If rotation of the mobile served to elicit foot thrusting it might be expected that the subject would be more likely to respond while the mobile was in motion rather than when it was stationary. The fact is that this subject was about twice as likely to respond while the mobile was stationary. Response rate during mobile rotation was 5.1 per minute. It was ten responses per minute during the time the mobile was stationary.

The data from this study do not support the general observations made by others that vigorous smiling emerges in infants as their motor behavior comes under operant control. The most striking characteristic of the smiling data is their variability which suggests that unknown factors affected this behavior. Research might be directed to determine what variables control infant smiling.

In contrast to smiling, cooing clearly increased after a few days of exposure to contingent stimulation. Cooing is a behavior which has a great deal of social significance for the human infant. "Minimal units" (Skinner, 1969, p. 176) is a term used to describe early forms of behavior which are subsequently shaped into complex repertoires. Cooing may be a minimal unit of speech in that many sounds relevant to speech first appear in the form of cooing. The necessary and sufficient conditions generating this important behavior can only be speculated upon at the present time.

For example, it is possible that increased motor activity generates increases in infant cooing regardless of changes in the amount or nature of environmental stimulation provided. Simply stated, increases in motor activity may produce proportional increases in cooing. Session by session comparisons of foot thrust and cooing data obtained in this study do not support this speculation.

One alternative explanation for the increase in cooing has been offered by Watson and Ramey (1972). They hypothesize that cooing is an adjunctive emotional response which accompanies "contingency awareness" (Watson, 1966; 1967; 1972). Contingency awareness is defined as "...an organism's readiness to react adaptively in a contingency situation and to an organism's sensitivity in the perception of contingency situations when they occur." (Watson, 1966, pp. 123-124).

An extension of the "contingency awareness" hypothesis is the speculation that human infants may be genetically programmed to "reinforce the reinforcer." The tendency to coo when exposed to reinforcement contingencies may have been selected by evolutionary processes. Most contingencies experienced in early infancy are mediated by adults and it logically follows that the more responsive infants are, the more likely prolonged interactions with adults may become. Hunt, in an interview by Maya Pines (1979), has reported statistics which confirm the tremendous impact infant responsiveness may have on increasing interaction with adults. He found that the percent of toddlers being reared in a Teheran orphanage who were subsequently adopted rose from 4% to 64% after they were exposed to reinforcement contingencies which resulted in increased responsiveness to caretakers. Infant behaviors which lead to prolonged adult interaction have obvious value since human infants are dependent upon adults for survival.

Given presently available technology, it is impossible to directly measure infant perceptions of contingencies. It is possible, though, to determine whether the existence of a contingency between motor behavior and reinforcing stimulation is a necessary and sufficient condition to generate cooing. Research might be directed toward distinguishing the effects contingent and noncontingent periodic stimulation have on cooing.

Other potential explanations for the increase in cooing exist. If response-independent schedules of reinforcement are shown to be equally effective in generating cooing, then this behavior may be viewed as either "superstitious" (Skinner, 1948) or schedule-induced (Staddon, 1977).

Skinner (1948) has defined superstitious or adventitiously reinforced behavior as behavior which is strengthened by being accidentally paired with the presentation of a reinforcing stimulus. A response occurs for unspecified reasons, is accidentally followed by a reinforcer and as a result occurs with greater frequency. It is possible that cooing was generated in this manner. Use of a cumulative recorder to determine the distribution of cooing responses in relation to reinforcer delivery might enable one to evaluate this explanation. Adventitious reinforcement as an adequate explanation gains support if it is found that cooing occurs contiguously with mobile rotation or that short cooing-contingent delays of reinforcer delivery result in a reduction in cooing.

The existence of a contingency, accidental or planned, is irrelevant to the view that cooing may be a schedule-induced adjunctive behavior. Instead of focusing solely on the relationship between responding and reinforcement, this explanation focuses on the correlation between reinforcement and temporal and stimulus variables (Staddon, 1977). Falk (1971) has defined this adjunctive behavior as "...behavior maintained at high probability by stimuli whose reinforcing properties in the situation are derived primarily as a function of <u>schedule parameters</u> governing the availability of another class of reinforcers." (p. 586, emphasis added). He was referring to the behavioral phenomenon known as polydipsia (i.e., the ingestion of excessive quantities of water by animals exposed to intermittent schedules of food reinforcement) but the definition might also apply to cooing generated in this study. Schedule-induced behavior is not fully understood at the present time, but it appears to be controlled by variables relating to the motivational value of reinforcers. In order to evaluate this view, research which assesses the affects of intermittent versus massed presentation of the reinforcer is needed.

This study generates many more questions than it answers. Until more is known about the effects of artificially arranged contingencies of reinforcement on infants it seems reasonable to follow the advice given by Watson and Ramey to approach this form of early stimulation with caution. Specifically, exposure to such contingencies should be limited to a small percentage of the infant's waking time so that he or she has the opportunity to experience a variety of stimulating events.

REFERENCES

Brackbill, Y. Extinction of the smiling response in infants as a function of reinforcement schedule. *Child Development*, 1958, *29*, 114-124.

Clifton, R., Meyers, W. J., & Solomon, G. Methodological problems in conditioning the headturning response of newborns. *Journal of Experimental Child Psychology*, 1972, *13*, 29-42.

Etzel, B. C., & Gewirtz, J. L. Experimental modification of caretaker-maintained high-rate operant crying in a 6- and 20-week-old infant (infans tyrannotearus): Extinction of crying with reinforcement of eye contact and smiling. *Journal of Experimental Child Psychology*, 1967, *5*, 303-317.

Fagen, J. W., & Rovee, C. K. Effects of quantitative shifts in a visual reinforcer on the instrumental response of infants. *Journal of Experimental Child Psychology*, 1976, *21*, 349-360.

Falk, J. L. The nature and determinants of adjunctive behavior. *Physiology and Behavior*, 1971, *6*, 577-588.

Finklestein, N. W., & Ramey, C. T. Learning to control the environment in infancy. *Child Development*, 1977, *48*, 806-819.

Hillman, D., & Bruner, J. S. Infant sucking in response to variations in schedules of feeding reinforcement. *Journal of Experimental Child Psychology*, 1972, *13*, 240-247.

Papoušek, H. Conditioned head rotation reflexes in infants in the first months of life. Acta Pediatrica, 1961, 50, 565-576.

Pines, M. A head start in the nursery. Psychology Today, 1979, 13, 56-68.

Ramey, C. T., & Watson, J. S. Nonsocial reinforcement of infant's vocalizations. Developmental Psychology, 1972, 6, 538.

Rheingold, H. L., Gewirtz, J. L., & Ross, H. W. Social conditioning of vocalizations in the infant. Journal of Comparative and Physiological Psychology, 1959, 52, 68-73.

Routh, D. K. Conditioning of vocal response differentiation in infants. Developmental Psychology, 1969, 1, 219-226.

Rovee, C. K., & Fagen, J. W. Extended conditioning and 24-hour retention in infants. Journal of Experimental Child Psychology, 1976, 21, 1-11.

Rovee, C. K., & Rovee, D. T. Conjugate reinforcement of infant exploratory behavior. Journal of Experimental Child Psychology, 1969, 8, 33-39.

Schwartz, A., Rosenberg, D., & Brackbill, Y. Analysis of the components of social reinforcement of infant vocalizations. Psychonomic Science, 1970, 20, 323-324.

Sheppard, W. C. Operant control of infant vocal and motor behavior. Journal of Experimental Child Psychology, 1969, 7, 36-51.

Siqueland, E. R. Operant conditioning of head turning in four-month infants. Psychonomic Science, 1964, 1, 223-224.

Siqueland, E. R. Reinforcement patterns and extinction in human newborns. Journal of Experimental Child Psychology, 1968, 6, 431-442.

Siqueland, E. R., & Lipsitt, L. P. Conditioned head turning behavior in newborns. Journal of Experimental Child Psychology, 1966, 3, 356-376.

Skinner, B. F. "Superstition" in the pigeon. Journal of Experimental Psychology, 1948, 38, 168-172.

Skinner, B. F. Contingencies of reinforcement: A theoretical analysis. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1969.

Staddon, J. E. R. Schedule-induced behavior. In W. K. Honig & J. E. R. Staddon (eds.). Handbook of operant behavior. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1977.

Uzgiris, I. C., & Hunt, J. M. Attentional preferences and experience: II. An exploratory longitudinal study of the effects of visual familiarity and responsiveness. Illinois: University of Illinois, 1970. (ERIC Document Reproduction Service No. ED 039 938)

Watson, J. S. The development and generalization of "contingency awareness" in early infancy: Some hypotheses. Merrill-Palmer Quarterly, 1966, 12, 123-135.

Watson, J. S. Memory and "contingency analysis" in infant learning. Merrill-Palmer Quarterly, 1967, 13, 55-76.

Watson, J. S. Cognitive-perceptual development in infancy: Setting for the seventies. Merrill-Palmer Quarterly, 1971, 17, 139-152.

Watson, J. S. Smiling, cooing and "the game." Merrill-Palmer Quarterly, 1972, 18, 323-340.

Watson, J. S., & Ramey, C. T. Reactions to response-contingent stimulation in early infancy. Merrill-Palmer Quarterly, 1972, 18, 219-228.

Weisberg, P. Social and nonsocial conditioning of infant vocalizations. Child Development, 1963, 34, 377-388.